ANOMALOUS HEAT FROM ATOMIC HYDROGEN IN CONTACT WITH POTASSIUM CARBONATE

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Anomalous heat was observed when a nickel tube submerged in 0.6 molar K_2CO_3 was pressurized with hydrogen gas. Minimal heat was observed when 0.6 molar Na_2CO_3 was used. These results are consistent with a new atomic theory whereby atomic hydrogen can exist in fractional quantum energy levels--below the traditional ground state.

I. INTRODUCTION

Excess heat from electrolytic cells has been reported in a significant number of studies using a variety of procedures and calorimeter designs. These studies found, in most cases, many positive results using both light and heavy water.[1-6]

Light water electrolytic experiments conducted at Thermacore also show positive results. The most outstanding example is a cell producing 41 watts of heat with only 5 watts of electrical input power. This cell has operated continuously for over one year.[7]

There are many theories attempting to explain the physics and/or chemistry causing the excess heat. Some include a nuclear reaction; others chemical. The authors subscribe to the non-nuclear theories simply because our chemical, scintillation counter and photographic film measurements have not detected the presence of nuclear by-products above background. This is confirmed by most experimenters showing nuclear by-products orders of magnitude below those required to explain the excess energy.[9]

One theory that does not rely on nuclear reactions is proposed by Mills.[2] Mills claims that the atomic hydrogen produced by electrolysis at a nickel cathode reacts with a potassium carbonate catalyst to produce excess energy while making a new form of hydrogen as the "ash."

Thermacore has tested the Mills' theory by establishing the conditions for producing excess heat without using electrolysis. The nickel cathode of the Mills' electrolytic cell was replaced with a thin walled nickel tube containing high pressure hydrogen. The hydrogen molecules are dissociated into atomic hydrogen on the tube inside surface. The hydrogen permeates through the tube wall and contacts potassium carbonate on the outer wall. Energy is produced, and according to the Mills' theory a new form of hydrogen, without the need for electrolysis. The non-electrolytic test apparatus and results are described below.

II EXPERIMENTAL

A schematic of the non-electrolytic cell is shown in Figure 1. It consisted of 6.1 meters of annealed nickel tubing 0.160 centimeters outer diameter with a 0.025 centimeter wall. The tube was wrapped into a coil 4.3 centimeters long by 2.8 centimeters in diameter. One end of the tube was welded closed; the other end passed through the end cap of a cylindrical pressure vessel and connected to a Nupro SS4H isolation valve.

The cylindrical pressure vessel was annealed nickel 200 tubing 8.9 centimeters long by 3.5 centimeters outer diameter with a 0.160 centimeter thick wall. The end caps were machined from 0.318 centimeter thick nickel 200 plate and welded to the cylinder. The pressure vessel was protected by a 0.635 centimeter stainless steel pressure relief valve NUPRO R3A set at 133 atmospheres. A 0.635 centimeter NUPRO SS4H fill and vent valve was also attached to the upper end cap.

Temperatures were measured with an Omega 0.160 centimeter diameter type K, 316SS sheathed ungrounded thermocouple that passed through a Swagelock type 200R4B fitting welded to the bottom end cap. Temperatures were recorded using a microprocessor thermometer (Omega HH21) having a detection limit of $\pm$ 0.1°C.

The internals of the pressure vessel were cleaned by filling it with 0.6 molar K_2CO_3/3% H_2O_2 for 30 minutes. The solution was removed, and the pressure vessel was rinsed in distilled water. A fluid charge of 30 ml of 0.6 molar K_2CO_3 was added to the cylinder covering the coiled nickel tubing. A 17 bar nitrogen cover gas was used to suppress boiling within the pressure vessel.

The heater consisted of a 14.4 ohm, 1000 watt Inconel 600 jacketed Nichrome heater made by Watlow. It was wrapped around the outside diameter of the cylindrical pressure vessel and powered by a 110 VAC variable transformer Powerstat 3PN116C. The voltage ($\pm$0.1%) and current ($\pm$0.1%) were recorded with a Fluke 8600A digital multimeter. The heating power was calculated from these measured values and remained constant throughout the test.

The entire pressure vessel, valves, fittings, and associated tubing were covered with one inch of Fiberfax insulation. The effectiveness of the insulation can be established by noting that 35 watts of heater power were required to increase the temperature of the pressure vessel to 215°C above the 18°C room temperature ambient.

The tubing was leak checked before and after the test using a helium mass spectrometer leak detector with a sensitivity of 10^{-10} std cc/sec. Helium pressure inside the tubing was set at 2000 psi while the pressure vessel space was evacuated after connecting to the mass spectrometer. No leaks were observed.

A duplicate set of the experimental apparatus was fabricated to serve as a control. It was cleaned and treated identically as the K_2CO_3 apparatus except the control used 0.6 molar Na_2CO_3 as a working fluid in place of the K_2CO_3. Chemical analysis of the working fluid was done to

identify any potassium contamination. Mills' theory[2] shows that unlike K_2CO_3, Na_2CO_3 does not provide the 27.2 eV energy sink required to stimulate hydrogen electron transitions to fractional quantum levels. The theory predicts that no excess heat should be produced using Na_2CO_3

III RESULTS

The calibration and test results are shown in Figures 2 and 3. The procedure included a calibration run with the I^2R heater energized and the hydrogen pressure set to zero. This calibration run was followed by pressurizing the nickel coil with hydrogen for about 5 hours then venting the hydrogen to atmosphere. The individual steps taken are listed below:

- The inside of the nickel tubing was opened to atmosphere through the isolation valve. This condition existed during the calibration run; calibration results are shown in Figure 3.
- The I^2R heater power was set at 35 watts which resulted in a steady state pressure vessel temperature of 215°C above ambient. The 215°C temperature rise was used to help provide adequate hydrogen permeation through the wall of the nickel tube. This condition was held for 20 hours to assure steady state conditions existed.
- The inside of the 0.160 centimeter diameter nickel tube was evacuated and immediately pressurized with 70 atmospheres of hydrogen gas.
- The pressure vessel temperature began to rise as shown in Figure 2.
- At 301°C rise above ambient, the hydrogen pressure inside the 0.160 centimeter diameter tubing was vented to 1 atmosphere air to stop the reaction and prevent the potassium carbonate saturation pressure from actuating the relief valve.
- The vessel temperature began to drop immediately after venting the hydrogen.

The data in Figure 2 show an increase in cell temperature of 86°C after the application of hydrogen pressure inside the nickel tubing. The equivalent power required to provide this temperature increase has been estimated from the slope of the calibration curve shown in Figure 3 to be about 50 $\pm$ 3 watts.

A nominally identical test was done using the control apparatus with Na_2CO_3 as the working fluid. The results from this experiment are also plotted in Figure 2. Notice that only a slight temperature increase of about 5°C occurs when using the control; the associated power is about 3 watts as determined from the calibration curve of Figure 3.

Chemical analysis of the Na_2CO_3 working fluid was done to identify the amount of potassium as a contaminant. The results show potassium levels on the order of 8 ppm. The origin of this potassium and its contribution to the 3 watts of the anomalous heat are currently unknown.

IV DISCUSSION

The above test results show about 50 watts of anomalous heat are generated at the time hydrogen gas is allowed to diffuse from the nickel tubing into the potassium carbonate solution. Much less heat, on the order of 3 watts, occurs when using the sodium carbonate control. Analyses were done to identify alternative explanations for the source of heat in addition to that proposed by Mills. The results of these analysis are summarized below.

Gas Compression: The excess energy is initiated at the time hydrogen gas is released into the coil of nickel tubing. Analyses were done to determine if the energy released from compression of hydrogen could explain the increase in temperature observed during the experiment. Using the equation: Energy = ½ x Pressure x Volume shows that about 40 joules are generated during gas compression compared to the 9×10^5 joules generated during the five hour test at 50 watts of excess heat. Clearly, gas compression does not explain the excess heat.

Hydrogen Blanketing: Hydrogen permeates through the wall of the nickel tubing and collects in the nitrogen space above the potassium carbonate solution. Estimates show that within the first hour of the test about 0.3 cc of hydrogen will pass through the tubing wall. This small amount of hydrogen being a better heat conductor than nitrogen will slightly increase the heat transfer coefficient between the cell internals and the upper portion of the nickel cylinder. A modest temperature decrease is expected rather than the 86°C temperature increase observed during the test. Hydrogen blanketing is not expected to be the cause of the excess energy observation.

Chemical Reaction: Hydrogen could react with other material located within the tubing or pressure vessel. For example, the nickel oxide located on the tubing inside diameter will most likely be reduced by hydrogen when heated to 235°C. This reaction would be exothermic. The $NaCO_3$ control shows that, at best, this effect could account for 3 of 50 watts of anomalous heat observed using K_2CO_3.

Mills' Theory[2]: The electron of the hydrogen atom is predicted to fall to fractional energy levels, n = ½, ⅓, ¼, and so on, thereby releasing energy when contacting a resonant energy sink of 27.2 eV. The "ash" of the process is the "shrunken" hydrogen atom called a hydrino. Two hydrinos will react creating a dihydrino molecule forming what is reported by Mills to be an inert gas.[8]

Methods are being perfected by Lehigh University for detecting the hydrino atom.[8] One of these methods, called ESCA (Electron Spectroscopy for Chemical Analysis), has been shown to be capable of identifying the hydrino atom absorbed on the surface of nickel cathodes used in electrolysis of K_2CO_3. This work shows a peak at 54.6 eV the energy predicted by Mills to be the binding energy of the electron for the hydrino atom H(n = ½) in vacuum.

ESCA analyses were also done by Lehigh on a virgin sample of nickel tubing as well as a sample removed from a K_2CO_3 diffusion cell. The results of these analyses show the characteristic hydrino peak at 55 eV for the sample used in the diffusion cell; no peak is seen for the virgin sample. This peak is shown in Figure 4 helping to confirm that excess energy can be produced by diffusion of hydrogen through nickel as well as by electrolysis.

V CONCLUSIONS

An exothermic reaction occurs when conditions exist for contact between hydrogen atoms and potassium carbonate on a nickel surface. These conditions were achieved by diffusing hydrogen through a nickel tube submerged in a 0.6 M solution of potassium carbonate. This exothermic reaction could be similar to that observed by Thermacore and others during electrolysis when using a nickel cathode in a 0.6 M solution of potassium carbonate. The above conditions for an exothermic reaction are consistent with the theory of Mills[2] where a new form of hydrogen is produced at a lower energy state.

Thermacore is currently working under a U.S. Government contract to reproduce the above experiment in a configuration permitting direct measurement of input and output power. Material analyses will be done before and after the experiment to identify the lower energy hydrogen. Results will become available in the spring of 1994.

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LIST OF FIGURES

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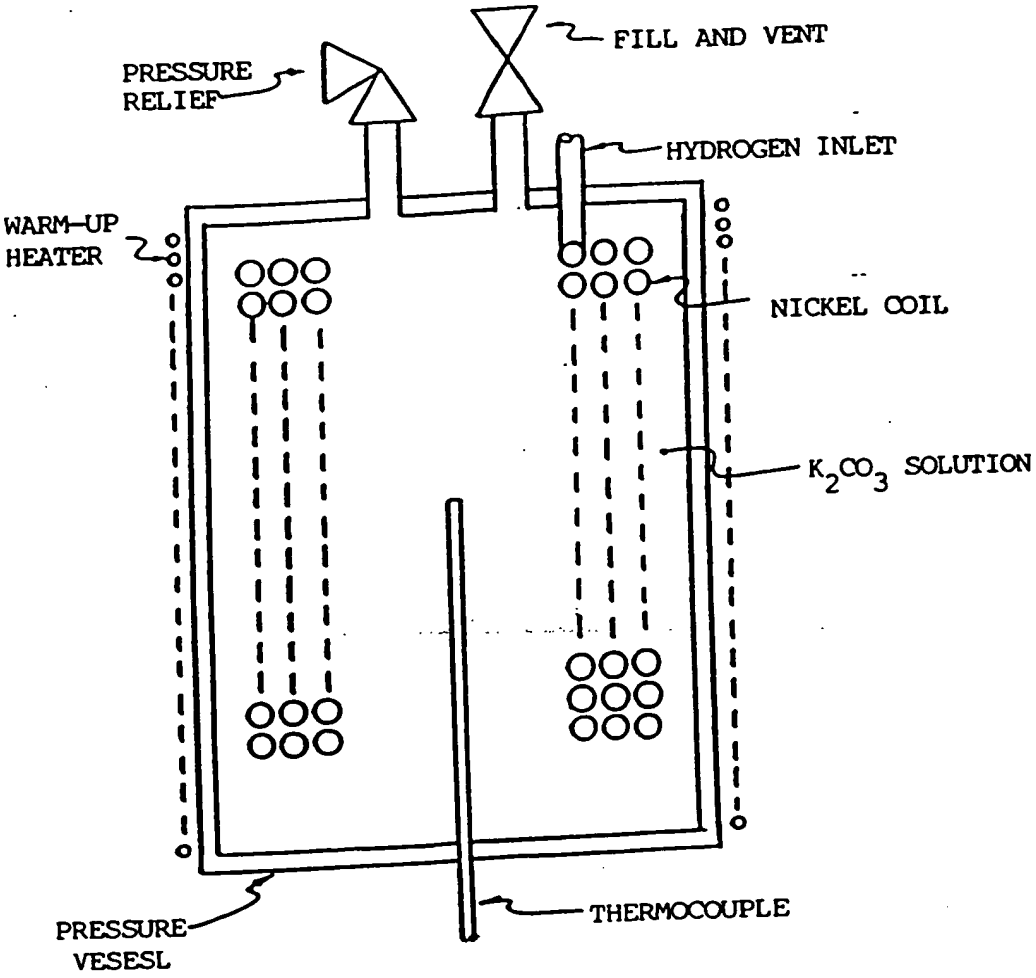
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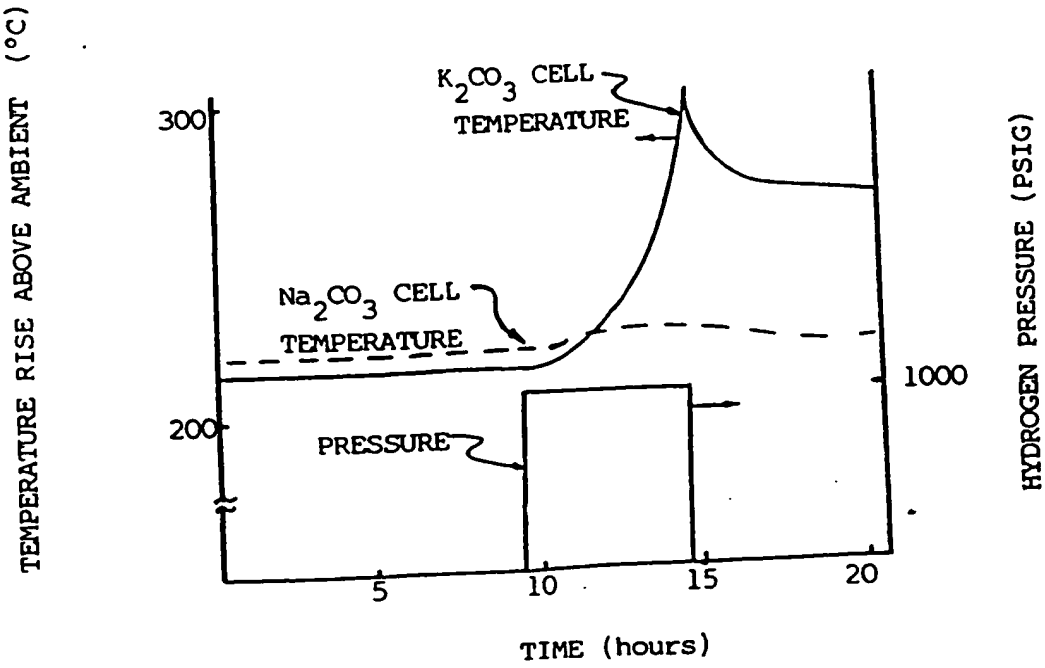
PRESSURE VESESL
THERMOCOUPLE

F-2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10
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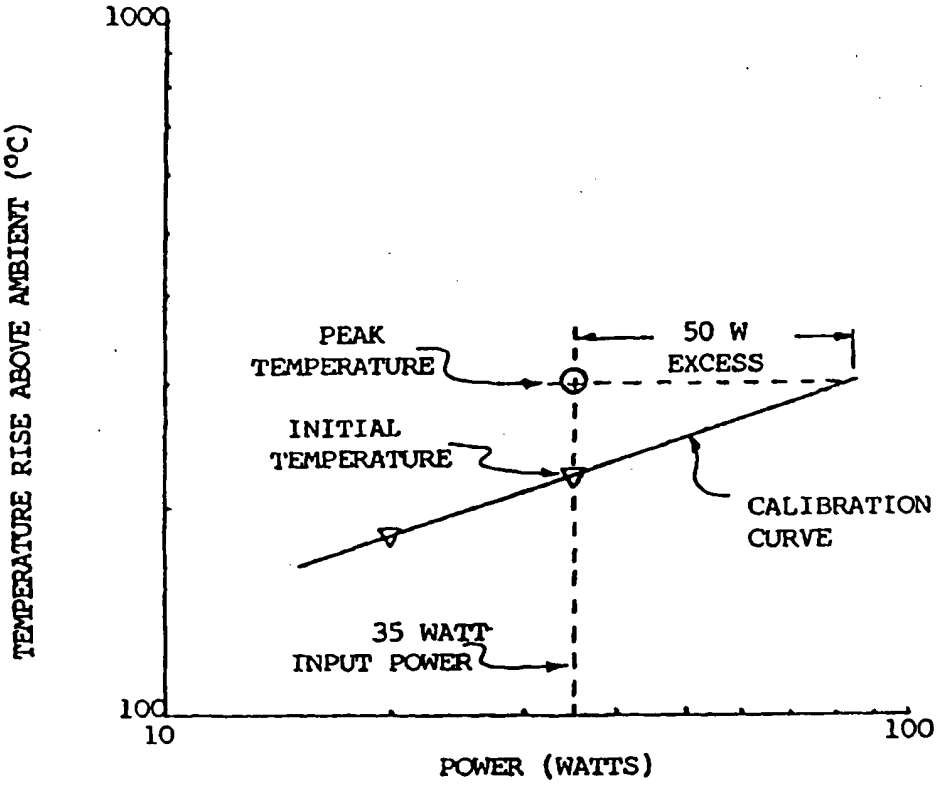
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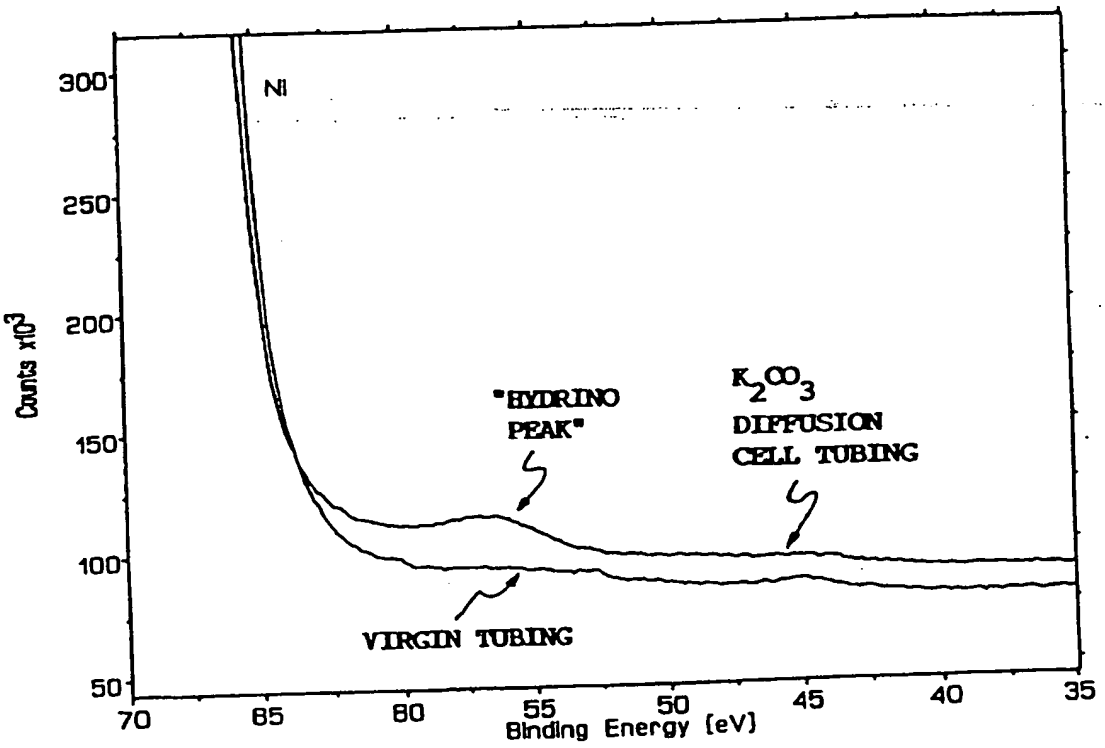
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VIRGIN TUBING
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250
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100
50
70
65
60
55
50
45
40
35
Binding Energy (eV)